

# NASA TECH BRIEF

## *Marshall Space Flight Center*



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### **Improved Printed-Wiring Boards for High-Reliability Circuits**

In some applications high-reliability electronic circuits are subjected to extreme temperature variations. The temperature variations cause cracked solder joints on the printed-wiring boards (PWB's). These failures occur because the joints and the boards have different coefficients of thermal expansion. A study was conducted to see if the reliability could be improved by changing the board coefficient of expansion. The results of this study are published in a report.

The report evaluates three polyimide laminates as PWB's and compares them with the commonly-used epoxy board. Two polyimide boards are commercially used; the third is an experimental model. The basic problem to be resolved is to find a board with the lowest coefficient of thermal expansion normal to the board plane.

Tests have been conducted on all three polyimide boards by subjecting them to temperature cycling between the temperatures of  $-55^{\circ}$  to  $100^{\circ}$  C using different time intervals. The experimental board has indicated the lowest coefficient of expansion ranging from  $15 \times 10^{-6}$  to  $20 \times 10^{-6}$  cm/cm- $^{\circ}$ C perpendicular to its plane. This value is less than half of those for the other boards.

The experimental board includes three layers of special tridirectionally woven fabric. Each fabric layer is impregnated with approximately 75 percent resin solution, 24 percent high-fired alumina, and 1 percent silane coupling agent. The alumina particles play a major role in reducing the coefficient of expansion.

They also serve as a heat sink for the heat-generating components. Two layers of special glass cloth are placed on each side of the fabric core. Finally two thin sheets of copper are bonded to the top and the bottom of the board.

The new board, described in detail in the report, has other desirable characteristics equivalent to those of the epoxy glass laminate boards. Its mechanical and electrical properties match those of the epoxy boards. In addition, it can be produced commercially using standard PWB technology.

#### **Note:**

Requests for further information may be directed to:

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#### **Patent status:**

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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Categories: 01 (Electronics - Components and Circuitry)  
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